formation of the structure of a metal, at a temperature so far below its melting point, and, in the case of the gold-antimony and gold-aluminium series, far below the melting point of the *eutectic* alloys, in the presence of only two-tenths per cent. of a foreign body, is probably not an isolated fact, and appears to open a new field for research.

" On the Relations between the Viscosity (Internal Friction) of Liquids and their Chemical Nature. Part II." By T. E. Thorpe, LL.D., F.R.S., and J. W. Rodger, Assoc. R.C.S. Received May 27,—Read June 11, 1896.

(Abstract.)

In the Bakerian Lecture for 1894 the authors gave an account of their work on the viscosity of over seventy liquids, and they discussed the interdependence of viscosity and chemical composition. In order to render the investigation more complete, they have now made measurements of the viscosity of (1) a number of esters or ethereal salts, and (2) of ethers, simple and compound—groups of liquids, which with the exception of ethyl ether, have not hitherto been studied by them. The physicochemical relationships previously established made such determinations of special interest, for it was shown that one of the most striking of the various connexions traced between chemical constitution and viscosity was the influence exerted by oxygen according to the different modes in which it was assumed to be associated with other atoms in the molecule. The influence which could be ascribed to hydroxyl-oxygen differs to a most marked extent from that of carbonyl-oxygen, and it appeared that ether-oxygen, or oxygen linked to two carbon atoms, had also a value which differed considerably from oxygen in other conditions.

In the present paper the authors give the experimental values for the viscosity of the ten lowest fatty esters, carefully purified samples of which had been placed at their disposal by Professor Sydney Young. With the help of Mr. Barnett, B.Sc., Assoc. R.C.S., they have also investigated the viscosity of five fatty ethers. By the kindness of the Photometric Standards Committee they have also been enabled to make observations upon various samples of carefully prepared isopentane, and they have supplemented their former observations by a new series of experiments upon ethylbenzene, for a sample of which they are indebted to Dr. G. L. Moody, of the City and Guilds Central Institute.

The details of the observations are given in precisely the same manner as in the first paper, and formulæ of the Slotte type showing

the relation between viscosity in absolute measure and temperature are calculated for each liquid. The general results of the observations are then discussed in the same manner as in the previous memoir. With regard to the two hydrocarbons, it is found that the isopentane from fusel oil gives slightly different values from that originally observed, which was obtained from American petroleum, and which, although of an approximately constant boiling point, was undoubtedly a mixture. The new sample of ethylbenzene, however, gave results which were in very good agreement with those previously obtained.

The conclusions relating to the graphical representation of the results may be thus summarised. Both ethers and esters give no evidence of molecular aggregation, and conform to the rules that:—

(1) In homologous series, the viscosity is greater the greater the molecular weight.

(2) An iso-compound has a smaller viscosity than a normal isomer.

(3) The more symmetrical the molecule of an isomeric compound the lower is the viscosity.

As regards the esters themselves, it is noteworthy, where the comparison is possible, that:—

(4) Of isomeric esters, the formate has the larger viscosity.

As regards the algebraical representation of the results, it is shown that in the expression $\eta = C/(1 + \beta t + \gamma t^2)$, derived from Slotte's formula:—

(1) In any homologous series, β and γ increase as the molecular weight increases.

(2) Of isomeric compounds, the iso-compound has the smallest coefficient.

(3) Ethyl ether, the symmetrical isomer, has smaller coefficients than methyl propyl ether.

(4) As regards normal isomeric esters, the formate has the largest, and the propionate the smallest coefficients, and the values of the acetate are larger than of the butyrate.

The authors then deal with the relationships existing between the various viscosity magnitudes—the viscosity coefficient, the molecular viscosity, and the molecular viscosity work—(1) at the boiling point, and (2) at temperatures of equal slope, the slope adopted being that employed in their previous paper, namely, 0.0_4323, and values for the oxygen in three different conditions are given for each system of comparison in the same manner as in their first communication.

The two main results supported by all the methods of comparison, both at the boiling point and at temperatures of equal slope, are:—

(1) That the effect which ether-oxygen exerts on the viscosity of
     a liquid differs to a marked extent from the effect exerted
     either by hydroxyl-oxygen or carbonyl-oxygen, and that

(2) The viscosity of the formate is abnormally large when com-
     pared with that of other esters, and indicates that the
     exceptional behaviour of formic acid is to some extent
     retained by its ethereal salts.

"On the Determination of Freezing Points." By J. A. HARKER,
D.Sc. Communicated by Professor SCHUSTER, F.R.S. Re-
ceived June 15,—Read June 18, 1896.

(Abstract.)

Of recent years great improvements have been made in the con-
struction of accurate thermometers. For their graduation and study,
the position of the thread for at least two fixed temperatures must
be known with certainty, and one of these is generally the freezing
point. According to many observers, the methods at present in use
for the determination of this point are unsatisfactory and cannot be
relied on, even when considerable precautions are taken, to more
than about $0 \cdot 001°$ to $0 \cdot 002°$. The object of the present communica-
tion is to describe a method by which more consistent results can be
obtained, and which is applicable to all kinds of thermometers.

The method adopted is to cool distilled water in a suitable vessel,
protected from radiation, to a temperature below $0°$, to insert the
thermometer, and then bring about the freezing of the water by
dropping in a crystal of ice. The thermometer then rises, and
finally attains a steady temperature, differing only very slightly from
the true zero.

Within the space allotted to this abstract, it is not possible to
describe in detail all the precautions to be adopted and the apparatus
employed, and for these reference must be made to the original
paper. The following brief outline may, however, be given.

The apparatus consists of two portions, the thermostat and the
cooler. The former is a rectangular copper vessel, filled with some
liquid, which can be cooled below $0°$ without solidifying.

Generally either refined petroleum or a strong solution of common
salt is employed. This vessel communicates by means of two wide
tubes with a system of coils in the cooler, through which the liquid
can be pumped by a rotary stirrer. These coils are surrounded by
a freezing mixture at about $-8°$, and by this means the circulating
liquid can be cooled and maintained for some time at about $-2°$.
The distilled water to be frozen is contained in a tube of about
300 c.c. capacity made of clear glass. This is first placed directly